

MODULE 4

OBJECTIVES

Upon completion of this module, the trainee, without the aid of references will be able to identify the following structures:

1. Head
 - a. Eyes
 - b. Ears
 - c. Nostrils
 - d. Beak

2. Integumentary System
 - a. Feathers
 - b. Feather tracts (pterylae)
 - c. Skin
 - d. Callosities
 - e. Toenails

3. Skeletal System
 - a. Sternum (breast plate)
 - b. Ribs
 - c. Vertebrae
 - d. Synsacrum
 - e. Ischium
 - f. Pubis
 - g. Femur
 - h. Tibiotarsus
 - i. Cnemial crest
 - j. Tarsometatarsus
 - k. Digits

4. Digestive System
 - a. Tongue
 - b. Esophagus
 - c. Proventriculus
 - d. Ventriculus
 - e. Duodenum
 - f. Pancreas

- g. Large intestine
 - (1) Ceca
 - (2) Rectum
 - h. Cloaca
 - (1) Coprodeum
 - (2) Urodeum
 - (3) Proctodeum
 - i. Vent
 - j. Liver
 - k. Gall bladder
5. Respiratory System
- a. Trachea
 - b. Syrinx
 - c. Bronchi
 - d. Lungs
 - e. Airsacs
6. Circulatory System
- a. Heart
 - b. Spleen
7. Reproductive System
- a. Ovary
 - b. Oviduct
 - c. Testes
 - d. Vas deferens
 - e. Phallus
8. Urinary System
- a. Kidneys
 - b. Ureters

9. Major Parts

- a. Neck
- b. Leg
- c. Thigh
- d. Drumstick

MODULE 4 SCRIPT

Introduction

Ratites (ostrich, emu, rhea) are flightless birds descended from flighted ancestors. They share many of the evolutionary adaptations of other birds, but some characteristics are unique.

Some generalizations can be made about ratites. All ratites can swim. The sutures of the ratite skull remain open throughout life. Male ratites have a protrusible phallus. All ratites have elongated **necks** and relatively long, heavily muscled **legs** adapted for running. All ratites use their legs and feet in both defense and offense by thrusting forward; larger birds can do this with disabling or lethal effect.

The Head and Organs of Special Sense

Ratites have excellent vision; ostriches have the largest vertebrate **eye** relative to body size. Also, the sense of hearing is acute. The external **ear** orifice is easily located caudal to the eye.

Unlike most other bird species, the **nostrils** are located at the rostral end of the elongated **beak**.

Integumentary System

Ratite **feathers** have no barbules, so their appearance is more like hair than feathers. Emu feathers have a double rachis (shafts) and are the most hair-like.

Feathers are not distributed uniformly over the surface of the skin but are

restricted to **feather tracts (pterylae)**.

The massive thighs of ostriches are devoid of feathers, but the legs of other ratites are feathered down to the tarsometatarsus. Like other birds, ratites have no sweat glands.

Callosities are dermal thickenings at strategic locations of wear (where pressure exists when birds rest.) Prominent callosities in the ostrich are located over the sternum and over the bony prominence of the pubic bones. Rheas and emu have only the sternal callosity.

The **skin** on the shin (shank) and top of the toes consists of large cornified scutes (scales). Smaller scutes cover the remainder of the skin surface in these areas.

The large digit (toe) of the ostrich has a large blunted **toenail**. The toenail on the small digit is less well formed. Toenails of other ratites can be sharper.

Skeletal System

The bony thorax (chest) of the ostrich is bounded by the thoracic **vertebrae**, the vertebral and sternal **ribs**, and the **sternum**. The unique ratite sternum gives this group its name (Latin *rat*is = raft). The sternum is concave dorsally and convex ventrally, somewhat like a raft. There is no keel, and the ventral surface has no pectoral muscles.

The thoracic (shoulder) girdle does not

support flight. The scapula, coracoid, and clavicle are fused in the adult bird and attached to the sternum. Wing development differs. The ostrich and rhea have relatively large wings, whereas, the emu's wings are rudimentary.

The fused vertebrae in the pelvic region of ratites is the **synsacrum**. The pelvic girdle consists of three paired bones: the ilia, the ischia, and the pubis. In the ostrich, the ischial and pubic bones fuse to form a **pubic symphysis**.

The patella (kneecap) is absent in ratites. In its place, in the ostrich, there is a small bone in the tendon of insertion of the muscle on the **cnemial crest** of the **tibiotarsus**. This crest provides extra leverage for quick, sure forward movement of the leg in running and swimming birds.

The **tarsometatarsus** is the shin bone, equivalent to the shank in chickens. The **tibiotarsus** is the ratite equivalent of the tibia-fibula (drumstick) in chickens, and the **femur** is the large thigh bone which articulates with the hip. The femur is the only pneumatic bone in the ratite.

Ratite toes are not all alike. The ostrich has two **digits** (toes) and other ratites have three.

Digestive System

The shapes of the **tongue** differ among ratite families. Ostrich tongues are smooth, blunt, and U-shaped, forming a pocket. Rhea tongues are thickened with V-shaped tips. Emu tongues have serrated edges.

The **esophagus** generally traverses down the right side of the neck. The crop is absent in all ratites.

The esophagus enters the **proventriculus** which is located within the thoracic cavity. In contrast with other birds in which the entire inner surface of the proventriculus secretes digestive enzymes, the enzyme/acid secretory function in ratites is restricted to a patch on the greater curvature of the organ. The differences in the proventriculi might be related to diet. The large, thin-walled ostrich proventriculus accommodates dry, bulky food. Since both its proventriculus and gizzard contain rocks, the ostrich is perhaps the only ratite in which the proventriculus has a grinding as well as glandular function. Other ratites subsist on diets with higher moisture content, therefore, they have smaller glandular proventriculi.

The proventriculus empties into the **ventriculus (gizzard)**. The ratite ventriculus is a thick-walled structure similar to the ventriculus of seed-eating birds. It often contains rocks and has a grinding function. The lining of the ventriculus is tough and dark.

The **duodenum** is the first of three parts of the small intestine. It forms a loop, with the **pancreas** lying between the loops. The jejunum is the second part of the small intestine. The **ileum**, the third part of the small intestine, is the longest part and is very coiled. The ileum, which lies between the ceca, enters the **large intestine**.

The **ceca** are paired in ratites. In the ostrich, the ceca are elongated. The

ceca of the emu are short and nonfunctional.

The **rectum** is the longest part of the intestinal tract in the ostrich, probably because it is necessary for digestion of bulky food items and fluid absorption.

The ratite rectum enters the **cloaca**. The **cloaca** consists of a rectal pouch called the **coprodeum**, which receives the rectum; an **urodeum**, receiving the ureters and genital openings (oviducts of female and vas deferens of male); and a terminal **proctodeum**, containing the phallus.

The **bursa of Fabricius** is on the dorsum of the proctodeum. Bursal follicles that normally disappear during development in other avian species (such as the chicken) are retained in the ostrich and emu.

The **liver** is adjacent to the ventriculus. The **gallbladder** is absent in the ostrich but present in the rhea and emu.

The **vent** is the external orifice of the digestive tract.

Respiratory System

In most ratites, the **trachea** (windpipe) contains complete flexible cartilaginous tracheal rings. The trachea of both male and female emus, however, has a characteristic cleft that is not found in other ratites. Cartilage rings that are not fused into a complete circle form a slit that is found on the ventral side of the trachea just cranial to the tracheal bifurcation. In the young the cleft is

covered by a thin membrane, whereas, in the adult the membrane becomes an expandable pouch. When the emu forces air into the pouch, the skin of the neck expands and a drum-like sound, called "booming", is produced, primarily by the female. In males, a growling sound results. Booming is heard throughout the year, and is not necessarily associated with courting activities. In all ratites, the trachea bifurcates into the **bronchi**.

Like the chicken, the ostrich has a syrinx. Unlike the chicken, however, ostriches are relatively avocal; thus the **syrinx** is poorly developed.

Ratite **lungs** are imbedded in bony structures of the thorax.

The general anatomy of the **airsacs** of ratites is similar to that of flighted birds. Ratites have a cervical airsac, a clavicular airsac, cranial and caudal thoracic airsacs, and abdominal airsacs.

Circulatory System

The **heart** is four chambered, similar to that of other birds and mammals.

The **spleen** of the ostrich is oval and elongated (sausage-shaped), situated on the right side of the proventriculus and cranial to the kidneys. Spleen location is similar for the rhea, but its shape is that of a bent cylinder. The emu spleen is long and cylindrical.

Reproductive System

As in other birds, usually only the left **ovary** and **oviduct** develop in ratite

females. (There is no right ovary or oviduct.) The left ovary is suspended from the dorsal body wall, ventral to the kidneys. The size, shape, and position of the ovaries varies greatly, depending on the breeding cycle. The genital duct empties into the urodeum of the cloaca.

The paired **testes** of the males are situated ventral to the kidneys, enlarging during the breeding season. Testes, which are tan in the ostrich and rhea, but black in the emu, empty into the urodeum of the cloaca. Semen travels through the **vas deferens** from the testes to the urodeum.

Male ratites have an intromittent organ commonly called a **phallus**. Although the avian phallus is analogous to the

mammalian penis, the organs are not homologous. There is no urethra in the avian phallus, and it does not have a urinary function as does the mammalian penis.

Urinary System

The **kidneys** and **ureters** of ratites are similar to those of other birds.

The two elongated kidneys lay symmetrically in the bony depression of the synsacrum. They are red-brown with a granular appearance.

Although there is no urinary bladder, a dilated pouch of the ureter stores urine in the rhea. The ureters empty into the urodeum of the cloaca.

MODULE 4

SUPPLEMENT

Complete the following using the script as the reference.

1. Ratites have excellent _____; ostriches have the largest vertebrate eye relative to body size.
2. Ratite _____ have no barbules, so their appearance is more like hair.
3. _____ are dermal thickenings at strategic locations of wear (where pressure exists when birds rest).
4. The unique ratite _____ gives this group its name (Latin *ratīs* = raft).
The sternum is _____ dorsally and _____ ventrally, somewhat like a raft.
5. The _____ (shoulder) girdle does not support flight. The scapula, coracoid, and clavicle are _____ in the adult bird and attached to the sternum.
6. The ostrich and rhea have relatively _____ wings, where as the emu's wings are _____.
7. The fused vertebrae in the pelvic region of ratites is called the _____.
8. In the ostrich, the ischial and pubic bones _____ to form a pubic symphysis.
9. The tarsometarsus is the _____ bone.
10. The tibiotarsus is the ratite equivalent of the tibia-fibula in chickens and is located in the _____.
11. The _____ is the only pneumatic bone in the ratite.

12. The shapes of the _____ differ among ratite families.
13. Since both its _____ and gizzard contain rocks, the ostrich is perhaps the only ratite in which the _____ has a grinding as well as glandular function.
14. The _____ is the first of three parts of the small intestine. It forms a loop, with the _____ lying between the loops.
15. The _____ is the longest part of the intestinal tract in the ostrich, probably because it is necessary for the digestion of _____ food items and fluid absorption.
16. The _____ consists of a rectal pouch called the coprodeum, which receives the _____; an _____, receiving the ureters and _____ openings _____ of female and _____ of male); and a terminal _____, containing the phallus.
17. In most ratites, the _____ (windpipe) contains complete flexible cartilaginous tracheal rings.
18. The trachea of both male and female emus has a characteristic _____ that is not found in other ratites.
19. The general anatomy of the airsacs of _____ is similar to that of flighted birds.
20. Ratites have a _____ airsac, a _____ airsac, _____ and _____ thoracic airsacs, and _____ airsacs.

21. As in other birds, usually only the _____ ovary and _____ develops in ratite females.
22. Testes, which are _____ in the ostrich and rhea, but _____ in the emu, empty into the _____ of the cloaca.
23. Semen travels through the vas deferens from the testes to the _____.
24. The two elongated kidneys lay symmetrically in the bony depression of the _____. They are _____ - _____ with a granular appearance.
25. Although there is no urinary bladder, a dilated pouch in the _____ stores urine in the rhea.
26. The ureters empty into the _____ of the cloaca.

The anatomical part is matched with the letter from the figure on page 4.12.

Head A

Beak B

Nostril C

Eye D

Neck E

Feather tracts F

Wing G

Breast H

Callosity I

Thigh J

Drumstick K

Shank L

Foot M

Toe N

Claw O

Tail P

The anatomical part is matched with the letter from the figure on page 4.14.

Skull A

Cervical vertebrae B

Thoracic vertebrae C

Synsacrum D

Ilium E

Ischium F

Pubic bone G

Sternum (breast plate) H

Wing bones I

Femur (thigh) J

Tibiotarsis (drumstick) K

Tarsometatarsis (shin) L

The anatomical part is matched with the letter from the figure on page 4.16.

Esophagus	<u> A </u>
Proventriculus (stomach)	<u> B </u>
Ventriculus (gizzard)	<u> C </u>
Pancreas	<u> D </u>
Small intestine	<u> E </u>
Large intestine	<u> F </u>
Cecum	<u> G </u>
Rectum	<u> H </u>
Cloaca	<u> I </u>
Coprodeum	<u> J </u>
Urodeum	<u> K </u>
Proctodeum	<u> L </u>
Vent	<u> M </u>
Liver	<u> N </u>
Gall bladder	<u> O </u>
Spleen	<u> P </u>
Kidney	<u> Q </u>
Ureter	<u> R </u>